VOL. XII. No. 22. OCTOBER 28, 1915

THE JOURNAL OF PHILOSOPHY
PSYCHOLOGY AND SCIENTIFIC METHODS

WHAT IS PURPOSIVE AND INTELLIGENT BEHAVIOR FROM THE PHYSIOLOGICAL POINT OF VIEW?

IF we may speak of the behavior of living organisms as being ruled by motives, it is clear that in nearly all instances these motives are severely practical in character. Some *end* favorable to the individual or to the species appears to be held in view; and this end must frequently if not usually be attained, otherwise the species would not continue to exist. Apparently, the general "purpose" of most animal actions is to take some advantage of conditions existing in the environment, or to modify the relations between the individual and the environment in some way favorable to the species. It is these externally directed actions which form the greater part of what is known as "animal behavior," and they represent an important, though not the only, means by which the animal adapts itself to its environment. Ordinarily we class such actions partly as "instinctive," partly as "intelligent"; perhaps their most remarkable feature is that they often have reference to a future more or less remote—they can not be understood by taking into account present conditions alone. This is why they impress us as "purposive." The "teleological" characteristic of living beings appears most conspicuously in this aspect of their life. But from the physiological point of view it is necessary to reach some purely objective or physicochemical definition of the term "purposive" as applied to such actions. The concept is clearly one derived from the age-long introspective experience of human beings, which shows purpose to be essential to effective human action; and the conception of adaptive behavior as being necessarily determined and guided by purpose has become firmly fixed in the mind of the race. To most persons, indeed, this conception seems inevitable or even innate; action directed toward a definite end is unintelligible without assuming the existence of some underlying purpose. When adopted in the philosophical sphere, and applied to the cosmic or evolutionary process as a whole, such a point of view leads to a teleological conception of nature; the whole evolutionary process then appears as essentially the expression

of purpose; the *teleological*—the realm of ends—is contrasted with the *mechanical*, as if their natures were inherently disparate,—representing, in fact, two distinct tendencies in nature. Accordingly, certain thinkers contend that the living organism—that part of nature where teleology is most evident—can not be a mechanistically actuated system merely. Something else is needed to account for its special peculiarities; and this something is usually assumed to be *that* of which we are conscious in purposive action; the organism is then conceived as the expression of a purposive agency,—the "entelechy" of Driesch and other vitalists. How are we to reconcile this idea with the conviction—which becomes more firmly based as physiological science advances—that the organism, considered as a material system in external nature, has no peculiarities that may not ultimately be accounted for on the basis of its physicochemical constitution alone?

Physiological science views the organism as a physicochemical system of a special kind, peculiar in exhibiting a unique chemical composition and a metabolism, and often a high degree of complexity, but otherwise similar in its properties and modes of operation to a non-living system. Can purposive or intelligent action be shown to be a possible or even necessary characteristic of material systems with the peculiar constitution of living organisms, and possessing their characteristic relations to an "environment"? This is the question which I propose to discuss in the present paper. My procedure and methods of reasoning will be those of objective natural science purely; and purposive actions, whether instinctive or intelligent, will be considered simply as events in external nature, disregarding their possible conscious or psychic accompaniment. I hope to show that action having all of the external marks of purpose is not in its general nature something distinctive of living organisms alone, but that it is, regarded mechanistically,[1] simply one of the many means by which a complex physicochemical system, exhibiting a metabolism and preserving an equilibrium with a changing environment, maintains its characteristic equilibration.

First we shall endeavor to define as clearly as possible what is meant by the concept of organic "adaptation," and by the term "adaptive" as applied to various physical properties, structures, and activities in organisms. The substantial meaning of those terms, in the physiological sense, can be indicated very simply. Disregarding the complex and variable detail always found in special cases of adaptation, we find on closer analysis that all adaptive features or devices have one property in common—namely, that of furthering the continued existence of the species. *An adaptation is a species-*

[1] *I. e.*, as conditioned by physicochemical factors alone.

conserving characteristic. An organism is said to be adapted to its environment when it exhibits physical properties, structural characters and activities of such a kind that its development, growth, and continued existence in that environment are ensured. Lack of such adjustment means early or eventual extinction. The question then becomes: what is the nature of the interaction that makes such continued existence possible? To answer this question in detail is the task of physiological science; but in general the essential peculiarities common to living organisms, as distinguished from non-living systems, may be defined quite simply. First, there is in all organisms a specific transformation of material and energy, taken from the surroundings, into the characteristically organized and active substance of the organism; and, second, the organism, once formed, exhibits automatic and other activities of such a kind as to conserve and perpetuate its own existence and that of the species. That is, these activities have as their eventual effect the securing of the materials (food, water, oxygen, salts), energy, and other conditions (*e. g.,* environmental) which are necessary for the continuance of this specific transformation. The latter is carried on automatically and independently in each individual. On its chemical side it includes the constructive processes of metabolism; by the destructive processes, chiefly oxidations, is furnished the energy utilized by the organism in its activities. It will be observed that we are here considering the organism as the *species,—i. e.,* as the whole succession of genetically connected and similar individuals. It is perhaps more usual to conceive of the organism as the single individual, which is conventionally[2] regarded as beginning its existence with the fertilized ovum and ending it with natural death; but this distinction may be regarded as unimportant from the present point of view. The existence of the species is apparently unlimited in space and time by inherent conditions, while that of the individual is limited,—both bodily size and length of life being more or less definite specific characters; but otherwise, so far as the possession of *living* characteristics is concerned, no essential distinction need be drawn. I emphasize here the conception of the organism as being constituted by the species rather than by the single individual, both because there is or has been—as a fact—material continuity between all individuals of the species, and also because it is important to remember that it is the continued existence of the species rather than of the individual which is the essential end-result of the organic activities in their

[2] "Conventionally,"—that is, for the reason that the germ-cells from which new individuals arise are genetically continuous with the parent organism, and it is arbitrary to say definitely when the life of the new individual begins.

totality; for, if this general principle is lost sight of, many highly characteristic features of animal behavior become unintelligible.

In general, therefore, we may class as adaptations all of those special peculiarities of form, physicochemical constitution, and behavior whose existence is favorable to the continued existence of the individual or the species. We may now make our definition somewhat more precise. For the sake of simplicity and brevity let us confine our consideration to the individual organism during the fully developed or adult period of its existence; what is needed for its maintenance? Primarily a balance between gain and loss of material and energy—a metabolic equilibrium. The physiological processes within the organism proceed automatically under normal environmental conditions (of temperature, milieu, etc.) so long as the supply of food, oxygen, and other necessary material from without is maintained; the external activities or "behavior" of the organism, thus, have reference chiefly to meeting this last requirement, *i. e.*, to maintaining the necessary supplies. We are supposing that the limits of growth have been reached; the essential requirement to be met, therefore, is that the supply of food and other necessaries shall not fall permanently below the loss. Under these conditions there is equilibrium,—balance of constructive and destructive processes—and life continues normally. Those external activities which directly or indirectly have the effect of maintaining this equilibrium are the ones which are characterized as *adaptive*. Adaptation, as a condition characterizing the relations between organism and environment, is thus defined with precision; it is simply the maintenance of the organic equilibrium; adaptive features of external structure or behavior are those which contribute to this end.

Observation shows that the external behavior of animals is very largely regulated by the requirements of this equilibrium. This is best illustrated by a concrete example; in all animals we find that when the supply of food is decreased below the normal the activity of the search for food increases correspondingly; there is increased reactivity to food-materials; this is the physiological correlate of "hunger"; the chances of securing what is needed to maintain the equilibrium are thus increased. The organic equilibrium is thus rendered more stable than otherwise it would be. Compensatory or regulatory devices of this or similar kind are especially characteristic of higher animals; and it is interesting to note that they have numerous analogies in the devices used to control the rate of energy-consumption in artificial mechanisms (thermostats, governors, rheostats, etc.). Not only is the supply of material from outside thus regulated, but alterations in the structure of the living system, or in its temperature, or in the chemical composition of its tissue-media,

may similarly call forth automatic counter-processes (regeneration, altered heat-production or heat-loss, anti-toxine production, etc.) which tend to restore the normal conditions. Adaptive external behavior thus appears as one out of a large number of *regulatory* processes or activities, all of which play their part in conserving the normal equilibrium between organism and environment. Generalizing more broadly—but without altering the essential significance of what has just been said—we reach the conclusion that in any stable or well-adapted species the total action of the environment upon the organism is exactly counterbalanced by the total activities of the organism. The interaction is reciprocal, and normally results in an adjustment which renders prolonged equilibrium possible. The complexity of the processes of adjustment in the organism thus corresponds to the complexity of the environment—*i. e.*, of that part of the external world with which the organism enters into relation. In higher animals the response is delicate and selective to a degree that makes detailed physiological analysis difficult or impossible. But in all cases the essential relations between organism and environment are similar; there is an interaction involving on both sides many components, the integral effects of which on either side are typically equal and opposite, and hence result in equilibrium.

From this point of view the case of a higher animal differs only in degree of complexity from that of a lower. In general a complex and highly integrated system is more subject to derangement than one that is simpler; hence, it is not surprising to find that in its details the adjustment of higher animals involves the existence of regulatory arrangements and activities of a remarkably sensitive kind. This is well seen in external behavior. The organism responds to even the slightest changes in its environment. It is hardly too much to say that in a well-adjusted animal in a complex environment every physical event in the immediate surroundings or within reach of its distance-receptors calls forth an appropriate response—*i. e.*, the compensatory physiological correlate of the environmental change. The action of a sparrow in city streets well illustrates this. So true is this that a skilled naturalist can deduce much of the character of a previously unknown animal's environment from a study of its structural and physiological peculiarities. Each organic feature has its complement in some feature of the environment. The complexity of the organism is thus the correlative or mirror-image of the complexity of external nature.

From such a point of view the organism is to be regarded as a physicochemical system of a special kind, exhibiting a dynamic equilibrium with its surroundings, *i. e.*, an equilibrium in which two sets of processes, one constructive or constitutive, the other destruc-

tive or dissipative, balance each other. Many other so-called "stationary" systems—characterized by a continual and balanced interchange of material and energy with the surroundings—exist in nature; a candle-flame, a vortex, a waterfall are instances; all such systems have in common certain definite general characteristics; hence, the comparison of a living organism with a vortex or candle-flame is traditional, and serves to make clear certain fundamental peculiarities of the living condition. One of the most interesting general properties of such systems is a certain power of regulatory adjustment to changes of condition, *i. e.*, an ability to maintain a definite form, constitution, and properties in spite of often extensive changes of external or internal conditions; connected with this peculiarity is a tendency of such systems to recover the original condition after disturbance. This durability of form or properties, in spite of continual change of composition, depends on the unchanging character or permanence of certain components of the system, in particular those which control the inflow and outflow of the material and energy constituting it. So long as these relatively stable—usually solid or *structural*—components remain intact, the other substances composing the system, and the conditions surrounding it, may change within considerable limits without affecting permanently the properties of the system itself. Thus the constancy of a candle-flame depends on the permanence and uniform properties of the wick and cylinder of paraffin and the supply of oxygen; the permanence of a vortex depends on some permanent configuration of the river-bottom, and so on. Similarly in the organism some permanent structural substratum must be assumed, which conditions in a specific manner the character of the perpetual metabolic transformation; so long as this substratum remains essentially unaltered the organism continues to "live," in spite of changes of food-supply or of external situation. Hence the organism, like a candle-flame or a fountain, tends to "right" itself after disturbance. Various analogies may be pointed out between the adjustments of inorganic systems of this class and the adaptive responses of animals, but it is unnecessary here to dwell on these in detail. It is, however, important at this stage in the discussion to recognize the general resemblance between such systems and living organisms; for many of the activities of the latter depend, in the last analysis, upon their having the general properties of physicochemical systems of this class.

We shall now consider more particularly the case of the living organism. For our present purpose we may divide the adaptive characters conveniently into two classes, (1) those having regard to the stability of the conditions within the organism itself (*e. g.*, special physiological functions like secretion, or special structures like the

heart-valves, etc.) and (2) those having regard to the stability of the relations between the organism and the environment. The second class form the subject of our immediate consideration; they include the various *external* adaptations—those which are directly concerned in the interactions between organism and surroundings. These may again be divided into two groups, first, those adaptive characters which may be described as *static,* consisting in various *permanent* peculiarities of form, color, or other physical property or structure (such as specific gravity in fishes, covering of feathers in birds, etc.); and, second, *active* adaptations, including all of the active responses which the organism makes in adjustment to changes in its environment. Instinctive and intelligent actions of all kinds belong in this second sub-class, which forms the chief subject of the present discussion; but since all such adaptive reactions exhibit certain general characteristics whose physiological significance is best made clear by a consideration of the static class of adaptations, we shall first consider the latter in some detail.

In all organisms part of the adaptation to environment depends on purely static conditions, which involve no external activity, either instinctive or intelligent, on the part of the organism. In such cases the external condition to which the organic adaptation has reference is to be regarded as *constant, i. e.,* as exerting its influence continually; it is a *permanent* feature of the normal environment, so that a permanent and relatively unchanging organic adjustment is sufficient to preserve the balance. This may be best illustrated by reference to one of the most general and constant physicochemical peculiarities of living cells. Consider, for instance, the cells of marine organisms; these are typically bathed by a medium which is either sea-water or has the essential composition of sea-water; obviously such a medium has a widely different composition from living protoplasm; and since protoplasm consists largely of crystalloid substances in a state of solution, it is evident that if free interchange of diffusible substances were possible the living system could not long retain its distinctive composition. This constant tendency to diffusive interchange is met by a simple compensatory physiological condition. The living cell is typically enclosed by a membrane or surface-film, the plasma membrane, which is impermeable to the diffusion of the majority of soluble substances contained in the cell and its medium. This "semi-permeability" of the plasma-membrane *insulates* the living system from its surroundings, and enables it to retain permanently its characteristic chemical constitution with the associated vital properties. Loss of material from the cell by diffusion is thus greatly retarded, if not entirely prevented; at least it is reduced to such a degree that little if any intake from the sur-

roundings is required to compensate the loss of essential cell-constituents by diffusion. The maintenance of a balance between supply and loss thus requires the expenditure of far less energy than would otherwise be the case. Interchange of material is in effect restricted to food and excretory substances, which are probably transported across the cell-boundary by some special physiological mechanism which acts intermittently. In brief, the disintegrative effects of diffusion upon the living system are prevented by the presence of a diffusion-proof partition. Some other cases illustrating the same general principle may be cited. The devices for preventing evaporation or loss of heat in terrestrial or warm-blooded animals furnish good illustrations. Terrestrial organisms, both animals and plants, are subject to continual loss of water by evaporation; this loss is limited by the presence of the general outer integument, which is typically waterproof to a high degree. It is important to note that in this case the condition is not purely static; the rate of evaporation varies with temperature and atmospheric conditions, and in correspondence with this we find that the skin of higher animals, or the epidermis of plant-organs like leaves, shows considerable variability in its power to resist loss of water. To the variability of the milieu corresponds a variability of the correlative organic structure; this kind of correspondence is highly typical of organisms, as already pointed out, and constitutes the second of the two aspects of adaptation defined above. The two, in fact, nearly always occur in intimate association with each other. Thus the plasma-membrane, though typically semi-permeable as just described, does not always act merely as a passive diffusion-preventing partition, but exhibits variations in its permeability, thus enabling the necessary interchange of materials to take place. A similar combination of static and active adaptive devices is found in the thermo-regulatory mechanisms of warm-blooded animals. Here the loss of heat is limited by the slowly conducting integument, so that normally the heat lost is balanced by that generated by oxidation within the body. In general the integument is the more efficient as a thermal insulator the greater the average difference of temperature between body and surroundings. This static arrangement is supplemented by various active mechanisms, which control the rate of evaporation from the skin, its blood-supply, the position of hair and feathers, rate of respiration, general muscular activity, and so on. Similarly, the provisions for balancing the supply and consumption of oxygen are partly static, although the static factors are relatively less important, especially in higher animals, where the oxygen-requirements vary widely according to the activity of the animal; nevertheless in all animals with respiratory organs the latter function continually, though at a rate which varies

with conditions and is subject to automatic regulation—usually through the influence of the chemical composition of the blood upon the respiratory motor mechanisms.

We may assume that analogous permanently acting arrangements would have been evolved to provide for the supply of the other chemical substances needed by animals, as food, salts, and water, were it not for the irregular distribution of such substances in nature. This has led to the development of various special activities and instincts; and it is chiefly by means of these that the necessary balance is secured. This statement, however, applies only to higher organisms; in those which obtain their carbon and nitrogen from a medium in which these elements are everywhere present in assimilable form—as is the case with most plants and a few animals—the process of intake is unintermittent (at least during light), and permanently acting devices suffice to preserve the equilibrium. Thus in green plants the carbon dioxide which enters the leaves is assimilated by a constantly acting photosynthetic process as rapidly as it enters; such an arrangement may be described as static in the present sense.

One static condition which is more generally looked upon as a special adaptation of a peculiarly vital kind is the protective coloration exhibited by so many animals; here we have a condition which is a factor in conserving the equilibrium between species and environment because it renders less appreciable to enemies the difference between the organism and other objects in the environment. The fact that insectivorous animals are in general indifferent in their behavior toward leaves, twigs, and similar objects, makes a resemblance to these a condition favorable to survival. Here the similarity to a physically balanced condition is less evident; yet in its essentials the situation is fundamentally similar to those already considered. The protective resemblance is the correlate, in the organism, of a certain constant condition in the environment, namely, the existence of a selectively acting agency, the activity of food-seeking animals, which is always at work to destroy edible forms of life. The condition for the effective operation of this agency is that the difference between edible and inedible objects should be apparent to the predatory species. Hence, when this difference is obscured the process of destruction is checked, and when the balance is reached the protected organism is more numerous than it would otherwise be. Protective resemblance in any organism is thus the compensatory physiological correlate of a certain definite environmental condition which tends constantly to diminish the numbers of the individuals forming the species.

The most constant general features in the geometrical form and external symmetry of animals can similarly be shown to be static

adaptations in the above sense, *i. e.*, species-conserving characteristics whose correlative is some constant peculiarity of the environment. Thus sessile organisms (*e. g.* plants, hydroids, actinians, corals, etc.) tend to exhibit a radial symmetry; that this condition is essentially an adaptive one may be seen from the following considerations: To a stationary animal in a stationary environment, *e. g.*, a coral or a sea-anemone, the external space-relations are symmetrical; such an organism is living in a medium from which supplies are equally likely to reach it from all sides; to this environmental condition corresponds an organic symmetry which makes no distinction between directions; the structural parts are so disposed that the receptive organs (tentacles, etc.) reach out in several directions of space, typically separated by equal angles, converging toward the central mouth. The precise number of radii varies, as is well known, and was probably determined originally in the ancestral organism that fixed the type by partly casual conditions, having reference to economy of material, etc. In radiate organisms as we now find them (including plants as well as animals) the number of radii appears in general to be smaller the smaller the body-size; in organisms with a wide spread, like trees, secondary radii appear, and a dichotomously branching system develops, which is characteristically symmetrical; *i. e.*, the relations of the organism to the different directions of space are alike. This arrangement is the correlate of the fact that in their *physiological* relations, *i. e.*, as possible source of food material or other supplies, all regions of space are alike to such an organism.

Very different conditions are found in locomotor organisms; here antero-posterior differentiation, usually combined with bilateral symmetry and dorso-ventrality, is the rule. In what does the adaptiveness of this characteristic morphological plan consist? The general adaptiveness of antero-posterior differentiation in a motile animal consists simply in this, that when such an animal moves forward the external effect, so far as the animal is concerned, is the same as if all objects in the surroundings situated in advance of the animal (except those moving faster than itself) were to move *toward* its anterior end; similarly those situated behind move, relatively speaking, away from its posterior end. It is thus plainly advantageous to such an animal that its food-receptor organs—*i. e.*, mouth with the associated prehensile apparatus and the reflex arcs operating this—should be situated in advance, where external objects, including food, are (relatively speaking) *approaching* it rather than behind where they are receding from it. For the same reason the reflex arcs, with the associated special sense organs, controlling the locomotor apparatus, are situated anteriorly. The relations of such

an organism to the environment are evidently more favorable to the maintenance of a balance between supply and loss than would be the case with any other arrangement. The physiological space-relations in a moving organism are, in fact, asymmetrical in this constant sense, and to this environmental asymmetry corresponds the constant asymmetry of morphological plan characteristic of motile animals.

The differentiation into similar right and left halves is, in part, an indirect consequence of antero-posterior differentiation; but this alone is not sufficient to account for the condition, as we see in the case of many spirally swimming animals with well-pronounced antero-posteriority, like infusoria and rotifers, where bilateral symmetry is absent or obscured. Typically it is found associated with dorso-ventrality; the existence of this last condition, however, is ultimately to be referred to the action of *gravity;* gravity makes the relations *up* and *down,* though similar in a purely spatial sense, physically unequal, and occasions a corresponding inequality between upper and lower in organisms, as in all other physical systems subjected to its influence. This influence has acted gradually but constantly, and has determined the evolution of organic forms with the characteristic correlative or compensatory peculiarities. We find that external dorso-ventral differentiation is most pronounced in animals living on the land or on the sea-bottom; in pelagic animals it is in general less evident or absent. It seems probable that the condition originated in shore-living or bottom-living forms; it is obvious that supporting or locomotor structures (legs) acting by pressure or impact against a horizontal substratum like the land or sea-bottom are best placed, from the standpoint of mechanical effectiveness and economy of material, not when they are distributed uniformly over the whole body-surface, but when they are confined to a certain *portion* of this surface, corresponding apparently to that region which at any one time can be opposed to the substratum; this surface is thus defined as *ventral.* The dorso-ventrality of walking and flying animals is thus the physiological correlate of the general fact that their movement depends largely on the equal and opposite reaction of their bodies to pressure exerted in a prevailingly downward direction against a supporting medium or substratum. It is interesting to note that in swimming animals like fishes, which are supported by immersion in a medium of their own specific gravity, external dorso-ventrality is in general much less pronounced than in terrestrial or bottom-living animals.

The condition of bilateral symmetry has an intimate relation to both dorso-ventrality and antero-posteriority. Given these two conditions, it is clear that simple mechanical requirements will necessi-

tate the equal and symmetrical placing of locomotor organs on either side of the long axis. Otherwise any definitely directed forward locomotion will be impossible, or at least will be effected with difficulty,—*i. e.*, with disproportionate and wasteful expenditure of energy. Obviously this would be the case if the majority of walking or swimming appendages were situated to one side of the long axis. Constant shifts of position and direction of action would then be needed to propel the animal in a straight line. It is evident that any single push from a locomotor appendage against the substratum must inevitably cause some lateral deviation of the whole animal unless the action is exactly in the direction of the long axis. But with two equal and similarly placed appendages on opposite sides of this axis, the transversely directed component of the one action is compensated by the equal and opposite component of the other; random lateral displacement as well as rotation about the long axis is prevented. Bilateral symmetry of locomotor appendages is thus an advantageous arrangement for definitely directed forward locomotion; its general "adaptiveness" is thus evident from what has been already said about the essential physiological significance of antero-posterior differentiation. Bilateral symmetry in the locomotor apparatus will necessitate directly or indirectly bilateral symmetry in the remainder of the organization.

It thus appears that the fixed structural plan of the great majority of animals with reference to the three dimensions of space represents in reality an essentially adaptive or species-conserving correspondence to the most constant general features of the environment —those which are fixed and invariable in the very nature of mundane things—*i. e.*, the geometrical and the gravitational. It will be observed that there is only one plane of symmetry in such an animal, the sagittal—that including the direction of normal locomotion and dividing the body into equal right and left halves. It is also essential to note that the environment—*i. e.*, the external world *in its relation to the animal*—although it may have innumerable planes of symmetry when the animal is at rest, also *has only one plane of symmetry when the animal is moving forward.* This may be seen more clearly if we imagine the environment to be moving continually in one direction and the organism stationary, as, *e. g.*, in the instance of a water-plant attached by one end, or a fish maintaining a constant position in the centre of a running stream. Here the organism tends automatically to place itself with its sagittal plane parallel with that of the current;[3] the two sides of the organism are then equally

[3] *I. e.*, the median vertical plane of the current parallel to the direction of flow. The rheotropic reactions of fishes illustrate this tendency.

acted upon by the environment. In no other position is this the case. Now it is to be noted that the direct effect of the moving environment on such an animal (*e. g.*, a fish) is physically the same as if the animal were moving straight forward and the environment stationary. The two sides are equally acted on by the environmental conditions; anteriorly, however, these conditions are different from what they are posteriorly, and above from what they are below. The only symmetrical relations are the *lateral*, or right and left relations. If we now consider the environment as stationary and the organism as moving forward, the essential relations between organism and environment are seen to be the same. As already pointed out, the regions *toward* which such an animal is moving are quite differently related to it from those *away from* which it is moving; the regions above (*i. e.*, away from bottom) are different from those below (toward bottom). Only right and left are similar. The morphological similarity of right and left halves thus corresponds to the similarity in the right and left halves of the environment of the moving animal. When the latter moves forward it creates, as it were, a plane of symmetry in the environment corresponding with its own plane of symmetry.[4]

This analysis is not complete,[5] but it is probably sufficient for

[4] Any one can convince himself experimentally of this by contrasting the environmental conditions of a boat floating at rest—which are the same on all sides—with those of the same boat moving forward at high speed; the difference between fore and aft then becomes sufficiently evident; the whole environment (in its relation to the moving object) is *seen* to be divided into symmetrical right and left halves, separated by the vertical plane which includes the direction of motion. Thus the bilateral symmetry of a motile organism corresponds to the bilateral symmetry of the environment in which it moves,—and which may be regarded as moving relatively to it. The reciprocality in the relations between organism and environment could scarcely receive a better illustration. Lack of bilateral symmetry in a moving organism would, in fact, interfere with locomotion in a straight line. This principle applies to moving bodies generally; this is why boats, carriages, flying-machines, etc., are bilaterally symmetrical. The biological advantage of being able to move readily from one region to another in a *straight* line is that the change of position is effected with the least possible expenditure of energy. Economy is an important consideration to an organism engaged in the struggle for existence.

[5] The explanation of dorso-ventrality may be criticized as not taking sufficient account of the conditions in organisms like fishes and other swimming animals; but the fact is that in general dorso-ventrality is much less pronounced in these animals—at least externally—than in animals that are supported on a solid substratum. In other words, as the external conditions above and below approximate to equality, the organic conditions do the same. The contrast between bottom-feeding and pelagic fish and mollusca emphasizes this; contrast, *e. g.*, a darter with a flounder, or a limpet with a squid. Of course if a condition of dorso-ventrality and bilaterality has once been reached in any ancestral

the present purpose, which is to show that the permanent features of an organism's constitution exhibit a definite correspondence with the permanent features of its normal environment. And, further, that this correspondence is of such a kind as to favor the continued existence of the organism in that environment. We shall now see that the same is true with regard to the *changing* features of the environment. The general principle of adjustment is the same; the external activities or behavior of the organism show a constant correspondence with the environmental changes, and are in general compensatory in their effect; *i. e.*, they also tend to offset or equilibrate the disintegrative influences which the environmental conditions in general exert upon the organism,—in other words, have the effect of furthering the continued existence of the species in that environment.

In adaptations of this second class, the so-called "active" adaptations, conditions become more difficult of analysis. The simplest cases are, perhaps, the ordinary reactions of food-taking. In most animals there is a selective response to edible as distinguished from inedible objects; in many cases the basis of this response is a simple chemically actuated reflex; thus in the simplest metazoa, *e. g.*, *Hydra* or actinians, the tentacles react to the contact of food particles by capturing and conveying these to the mouth, but show no response to indifferent objects like pieces of paper. The food-carrying reflex is initiated by certain chemical substances usually contained in the food; a reflex arc terminated by special "chemo-receptors" forms the physiological mechanism. Such a reaction can hardly be called an instinct, since it is shown by detached tentacles as well as by those connected with the intact animal. Yet it is plainly adaptive, *i. e.*, ministers to the survival of the organism. What has such an action in common with instinctive or intelligent behavior?

In intelligent action the quality of "purpose" appears always to enter; there is conscious reference to the future; the present action so alters the conditions that future needs are met. This last is true also of most instinctive actions; only here there is no certain evidence of any conscious accompaniment. Both kinds of action must for our present purpose be considered as events of a purely physiological kind. What is the nature of the physiological mechanism that renders such action possible?

Now it may be said that a food-taking reflex is a "purposive" action (using the word in its purely objective connotation) since it has the effect of securing for the organism a supply of energy which

line, the descendants will tend to exhibit these characters, independently of environmental conditions, by virtue of the general principle of persistence or repetition so characteristic of organisms.

is utilized for future needs; in this sense, indeed, any action which provides for the continued existence of the organism may be called purposive. But the term as ordinarily understood typically has reference to some *special* future contingency not present at the time, and for which some definite preparation is made in advance. Interpreting the term in this sense, let us consider a few examples of purposive behavior in animals.

Instincts which seem to imply foresight are innumerable. Probably the most striking instances are those which relate to the perpetuation of the species. Here the organism acts in such a way that the future existence of its species is furthered, even though its individual life is sacrificed, as in fact is often the case. In general, all of the instincts centering on reproduction have directly or indirectly the effect of securing conditions favorable to the development of the fertilized egg up to a stage at which the new generation can care for itself. The instincts leading up to and connected with pairing all have this future reference; so, also, have those connected with the care of the young. If these acts are carried out in a certain definite way in each generation the continued existence of the species under the normal environmental conditions is ensured. Using more general terms, therefore, we may say that the ultimate effect of such actions is to maintain the equilibrium of the organism with external nature; they belong in the general class of *regulative* reactions, *i. e.*, those which either continually or at intervals compensate or correct deviations from the balanced condition; they provide for the persistence of the organic equilibrium, *i. e.*, of the species. The complete analysis of purposive instincts of this kind is, however, too complex for the present purpose, and it is better to select simpler for illustration.

Many animals in temperate zones make in the autumn or throughout the year special provision for passing the winter. Frogs hibernate, many birds fly south, squirrels collect stores of food, various insects such as bees do the same, others construct cocoons, cysts, or burrows in which they or their larvæ lie dormant during the cold period. The intelligent provisions made by human beings may also be classed here. How are these various reactions to be regarded from the physiological standpoint? It is first to be noted that all show one evident common characteristic. They may be regarded as *protective* reactions having reference to a certain definite and regularly recurring situation in the external world, namely, the coming of a prolonged period in which temperature is low and food is scarce. The behavior is such as to secure survival in the face of these changed conditions. Now what is especially to be noted is that in every one of the above cases the characteristic behavior, which has reference to

the *whole* situation, is called forth or initiated by only a *part* of the same, and often a quite inconspicuous part. Thus swallows respond to the advent of the chilly days of early autumn by gathering in flocks and flying south. The migration is an adjustment to the entire situation just defined, not simply to the external change which *initiates* the characteristic sequence of behavior; the immediately inciting occasion, the change of weather in autumn, requires in itself no special adjustment. But the connection between this change and the coming of winter is *constant;* in reacting thus to a part of the situation the animal in reality is adjusting itself to the whole.

In all instinctive actions which have future reference we find this to be the case; the action has reference either to the whole situation, or to a part of the situation which is not present at the time the reaction is begun; typically the reaction is set in motion by only a part, and often an insignificant part, of the whole external sequence of events;[6] but this part constitutes a sign or index of what is to follow; and it is to some part of this succeeding condition that the animal adjusts itself; this it does by beginning a reaction or series of reactions which in its early stages may seem to have no reference whatever to the situation in which it finds itself at the time. Such a reaction is unaccountable by reference to the present alone, and hence impresses human observers with a sense of purpose or conscious foresight. But it is clear that nothing of the kind is necessarily implied, any more than intelligent caution is implied in the behavior of a boiler which lifts its safety-valve when the steam-pressure approaches the danger-point. In both cases there is a permanent mechanism[7] which gives a definite response to a certain change of situation. This response provides against a future contingency. What is remarkable is that the conditions of the action and its ultimate effect are exactly what we should expect them to be if the whole situation were under the observation and control of some intelligent purposive agency. What are the conditions *in the organism and in external nature* that render possible such successful anticipation?

On closer examination such an instinctive action, though complex, is seen to have all of the characteristics of a simple protective or food-securing reflex, as regards both the conditions under which it is aroused and its ultimate effect on the life of the animal itself or of its

[6] *I. e.,* by some *constant precursor* of the situation which the reaction is adapted to meet.

[7] We are not now considering just how this mechanism came into existence. Of course the safety-valve is a product of purposive intelligence. But such intelligence has a physiological basis, or at least correlate, the nature of which we are about to discuss; hence both kinds of devices are ultimately of physiological origin.

species. In every case of a purposive instinct we find the organism reacting *in a constant manner* to a condition *that recurs with constancy.* The case differs from the direct reaction to the presence of food-material only in its complexity, and in the fact that the total situation to which adjustment is made *takes time to develop,* and, hence, an essential part of the reaction involving adjustment is made in advance. Thus the spider reacts to the conditions into which it is born—namely, a world with corners, branches, and crevices, and a certain concentration of flying insects—by constructing a web and lying in wait; the essential end-result of this—the species-conserving or equilibrating consequence—is the securing of food. The digger wasp responds to the presence of fertilized eggs in its oviduct by digging a hole, stinging a caterpillar on the ventral surface—which quiets without killing the prey—placing the victim in the hole, and laying eggs upon it. Here the sequence is more complex, but it is none the less constant, and corresponds to a similarly constant combination of conditions in nature,—namely, presence of caterpillars with ventral nerve cord, constant properties of the wasp's own eggs and larvæ, a certain consistency of soil, etc.; the eventual outcome of the behavior-sequence is also constant, namely, the development of a sufficient proportion of eggs to ensure the continuance of the species. In their general features these two examples are typical. There are always the two correlates (1) constancy of the situation in external nature, and (2) constancy of the physiological response, or behavior-sequence, which directly or indirectly effects the adjustment.

The perfection and ingenuity of many animal instincts is simply one of the essential conditions of their effectiveness; constancy in the external conditions is another; if on the whole such behavior did not secure survival, the organism, and its instincts with it, would soon die out. Thus, from the most general point of view, a purposive instinct involving a complex series of actions must be regarded as a species-conserving response to a certain constant, though temporally extended, natural situation; the sequence of events composing the latter may be long and complex, but if it is *constant*—so that when the earlier events occur the later are definitely predetermined—the organism may take in the early part of the sequence an action which puts it into advantageous relations with events or conditions appearing later. In such cases the organism may be said to have exhibited purpose. *Conscious* purpose is, however, no more implied than in the production of winter-eggs by daphnids, or of hooks, flying organs and other means of distribution by seeds; in the case of the daphnids the external or environmental correlative of the constant periodical formation of resistant eggs is

the constant recurrence of winter; in the case of the plant the correlative of bur-formation is the more or less frequent passage of fur-bearing animals through the wood; in that of flying organs like thistle-down, the constant presence of winds. In each of these instances the organic formative process precedes in time the appearance of the situation to which it furnishes adaptation. The feature common to all is a constancy in certain peculiarities of the external world; a correlative constant physiological process supplies definite corresponding means of adjustment or equilibration. We may say that there are always the two *routines* which show a fixed correspondence with each other, the one being the routine of external nature (*e. g.*, the regular recurrence of cold seasons, etc.); the other a certain metabolic or formative routine in the organism, involving priately reacting nervous and muscular mechanisms in others. Where the processes resulting from these two routines come into interaction they compensate each other. Hence it follows that in all cases the normal outcome of the organic activity is *species-conserving, i. e.*, adaptive.

It would seem that the characteristic human uncertainty about the future has made it difficult for men to realize the fundamental constancy of natural processes; and hence they have been perhaps unduly surprised at the complexity and detailed fitness of many instincts and habits involving future reference. Actually, however, the constancy of complex sequences in nature may be fully as great as that of simpler sequences like the succession of day or night or the recurrence of the seasons; and the fact that organisms show many special peculiarities of structure and behavior that as it were *count on* this constancy of sequence and condition in nature is from the above point of view not surprising. These physiological peculiarities are necessary to the stability of the organic equilibria. We must regard all cases of adaptation—whether depending on static peculiarities of form or structure or on special activities—as representing essentially, from the physicochemical point of view, *equilibria* of greater or less complexity. Conceivably the relation of an organism to external nature might be represented by an equation, one side formulating the conditions in the organism, the other those in external nature. Both sides of such an equation *might* be equally complex, but this is not always necessary. What is essential is that the *totals* of the two opposed or reciprocal sets of activities should balance each other. In some cases the activities of the organism may be reduced to relatively simple terms, *e. g.*, if the environment is uniform or the living system is well insulated from its surroundings; we find this general condition in plants. On the other hand,

when environmental conditions are changeable and complex, and the organism also is complex, such simple static arrangements can not suffice to secure equilibrium. Only systems with highly developed powers of regulation are capable of continued existence under such conditions. In this manner we may account for the evolution of the physiological complexity which we find in higher organisms; the complex and constantly changing environmental conditions require in the organism a correspondingly complex and changeable apparatus of regulation and response, if adjustment is to be effected. Such a general condition, in which complex and varying situations in nature are met and compensated by correspondingly complex and variable series of organic activities, reaches its acme of development in the kind of behavior known as intelligent.

The purely physiological distinction between intelligent actions (which are *conscious,* at least in their origination) and instinctive actions (which probably as a rule are carried out *unconsciously* like most other physiological processes) is difficult to define. In so far as intelligence consists in the proper *classification* of situations or occurrences—as a preliminary to acting in reference to them—it can not be regarded as essentially different from instinct. A situation is recognized by an intelligent agent as one of a certain previously experienced *kind*—or as a combination of such situations;[8] a response or series of responses, appropriate to that kind of situation, follows; in other words the *constancy* of the situation or of its elements is recognized, and it is met by correspondingly constant mode or modes of action. The complexity of the external situation thus reacted to may be very great; in such a case we must assume a corresponding complexity in the physiological correlate,—*i. e.,* in the structural and physicochemical conditions within the organism that underlie and determine the response. But there seems to be no need for assuming the operation of an inherently different kind of agency.[9]

[8] The analytical activity of intelligence comes in here. This appears to be physiologically analogous to selective reflex response. Normally any organism reacts selectively—*i. e.,* analytically—on its environment by means of the special sense-receptor termini of its reflex-apparatus.

[9] Many students of this problem lay stress on the *changeable* character of intelligent action, as contrasted with the stereotyped character of instincts. Intelligence is shown, *e. g.,* when an animal learns to respond effectively to an unfamiliar situation,—as when it learns to thread a maze, at the other end of which is its food-supply. Memory or power of forming new "associations"—*i. e.,* in the physiological sense, new kinds or combinations of neuromuscular connection—is implied here. Hence associative memory has been regarded as the objective criterion of intelligence by various authors. Memory is shown, objectively, in the modification of a reaction in a constant manner under

The part played by language in the intelligent actions of human beings is of course an enormous one. But language is known to be based on a recognition of the *constancies* or "universals" of experience; its very existence presupposes that the static facts, occurrences, modes and conditions of change, relations, etc., symbolized by words and word-sequences, have been repeated over and over again (sufficiently at least for their recurrent character to be realized), and will continue to be repeated. Hence it immensely facilitates the work of classification, *i. e.*, of recognizing a situation as belonging to a definite *kind*. This last, however, is the essential criterion of intelligent action; language, as an instrument of biological adaptation, is to be regarded as essentially a means to this end. Through its means experience is largely analyzed and classified in advance; the situation may be already clearly defined before it is met with; hence it is easily recognized, and the appropriate response is at once indicated or set in operation. How important this is for effective adjustment is obvious.

From this point of view words, and the concepts which they symbolize, represent or correspond to the various permanent physiological mechanisms (*e. g.*, reflex arcs and their combinations) which underlie and make possible the special active adjustments appropriate to the various situations in which the organism repeatedly finds itself. When the situation is recognized as belonging to a certain *kind*, for which an adjustment already exists in the organism, the problem of dealing with the situation is solved. The special physiological mechanism of adjustment required by the situation is

repetition of the external situation. In the process of learning the "intelligent" animal modifies its reaction in the direction of securing better and better adjustment to the situation. We must note, however, that whether the physiological mechanism of adjustment is already perfect at birth—as in the web-spinning instinct of spiders—or whether it is perfected by degrees under the control of experience (trial and error, etc.), *the end-result is the same, i. e., the establishment of a constantly effective physiological correlate to the constant environmental situation.* Once the proper mode of reaction has been learned its physiological basis tends to persist (given proper use), and the reaction is employed whenever the corresponding external situation arises. Undoubtedly the ability to modify the reactions until they accord with—*i. e.*, secure adjustment to—the outer situation is characteristic of intelligence; but the process of modification itself takes place in a constant manner (varying from species to species), and represents a special adaptive physiological property with a definite physico-chemical basis. Through its means the attainment of an effective correspondence between behavior and external situation is greatly facilitated. The end-relation, where constancy of response answers to constancy of situation, is more readily established. Intelligent action consists largely in tentative efforts to bring about this correspondence. Hence the behavior even of intelligent persons tends to become stereotyped as they become older and more familiar with their conditions of life.

readily activated or reinforced by the right word; this is a matter of common experience and needs no special emphasis. Hence to define a situation accurately by a word or sentence involves adjusting oneself to it. To a well-trained soldier the connection between the word of command and the action is inseparable.

No such summary treatment can do justice to the problem in detail. But its biological aspects are fundamental, and are only beginning to receive proper consideration. Intelligent action is to be regarded as a mode of organic response, and its special physiological prerequisites must be determined by scientific investigation. Especially is it necessary to single out those peculiarities which it possesses in common with other forms of response, both in animals and plants. Its affinities to instinctive behavior, and ultimately to selective reflex action, are to the physiologist unmistakable. Analysis, however, does not alter the total character of the thing analyzed; and the dignity of intelligence is not affronted by a recognition of its biological origin and affinities, while insight into its essential nature may be greatly increased. The intellectual apparatus of conceptual reasoning must be regarded as having a correlative physiological apparatus consisting of permanent organic predispositions or adjustments of various kinds;[10] these adjustments correspond to the various continually recurring situations which the organism must be prepared to meet in its normal life. There must be a physiological basis for logical processes. Even Aristotle recognized that in conscious reasoning there is a union of the "universal," or permanent category supplied by the mind, with the "particular" furnished by experience; the latter is thus definitely characterized or specified, *i. e.*, becomes an object of *knowledge;* and if need be the appropriate action may then be taken in reference to it. The physiological interpretation of this law is evident from the foregoing; to the "universal" corresponds the permanent physiological mechanism of adjustment within the organism; it is the "particular" event or condition in nature which calls this mechanism into action and so brings the organism into effective—*i. e.*, self-conserving—relations with its conditions of life. It is clear that an essential *constancy* in the conditions under which events take place, both within the organism and in external nature, is the main prerequisite to such interaction. But it is just such constancy which to the scientific observer is the most significant and wide-spread peculiarity of nature; investigation discloses everywhere continual recurrence of the same elements, both of static condition

[10] As already pointed out (foot-note, p. 607), in *intelligent* organisms many of these adjustments are to be looked upon, not as already permanent or stereotyped, but as in process of being made or perfected. This qualification, however, does not alter the essential nature of the case.

and event; the living and the non-living are alike in this respect.[11] Recurrence, however, implies permanence of condition; this peculiarity of the physical word points, therefore, to the permanent or essentially timeless character of the conditions underlying natural processes. To pursue those considerations in further detail would carry one beyond the limits of the present article.

RALPH S. LILLIE.

CLARK UNIVERSITY.

CIRCUMVENTING DARWINISM

THE theory of evolution is to-day so cherished among our collective possessions, so valued a treasure of the social mind, that it is almost impossible to realize the sense of outrage it once stirred. It controverted Biblical narrative, to be sure, and it committed the grave offense of upsetting or threatening to upset a social classification, the absolute distinction between the human creature and the brute, but worse than all it was a doctrine of change, a doctrine thrust on a century that was on its death-bed before it entertained the idea of transferring its interest from the permanent to the changing.

The dying century took the idea of change into consideration, but it did not seriously make up its mind. Nor did it do more than take the idea, as we might say, into further consideration, for in earlier periods change had not been wholly disregarded. It had been regarded as purposive, as designed; conceded to be uncontrollable by man, it was hypothecated as controllable by God, the agent of man. The argument of design was the concession made to the change recognized as inevitable.

Now the concept of the origin of species controverts the argument of design.[1] Change proceeding by successful variations is not teleological. As long as this revolutionary position of Darwinism was clear, it was bound to be withstood by conservatives of all kinds. And withstood it was, violently and successfully,—until by a process of obfuscation it had been rendered acceptable.

The obfuscation was brought about through suppression and distortion. The implications of change in the origin of species were eliminated and the survival of the fittest variation was interpreted

[11] See my article on "Vitalism *versus* Mechanism," in *Science*, N. S., Vol. 40, 1914, page 840.

[1] Cf. Dewey, John. "The Influence of Darwinism on Philosophy," page 8. New York, 1910.

as the survival of the best. The old argument of design becomes the new argument of progress.

This assurance of progress was snatched illicitly from Darwinism to sugar-coat the pill of change. We have changed just because we are superior, the theory of evolution is made to convey to the conservative; we are superior because we change, it means to the more radical. Either way it flatters group conceit. It imparts, too, the self-assuring sense of being born to a mission in the universe.

Now and again there has been a reminder that the theory of the successful variation does not mean the survival of the best. But the reminder is hardly a check upon the progressives. Life is a struggle, Darwin says so, they urge, a struggle between the sexes, between economic classes, between nations, between races. The struggle is a test of the best, and survival through elimination is all to the good of mankind.

It is an argument that backs any oppression of the weak by the strong, any claim to special privileges, any spirit of exclusiveness, any intolerance or brutality. It supports racial discriminations, international war, economic competition. It may be turned into a pleading for the existence of disease, for unwholesome conditions of all kinds. And, *mirabile dictu*, it has become as much of a club against changing such conditions as was once an all-wise Providence.[2]

But most of all the theory of evolution is used as an argument for working upon people rather than upon conditions, encouraging the will to power over fellow creatures rather than over the conditions they live under. It shifts the responsibility to nature; just as it once shifted it to God. Just as man operated upon man through the gods, he would now operate through nature, disguising his will to power under the mask of natural selection. God punished the wicked—Nature weeds out the fellow in the way, the unfit.

And so perverted, Darwinism has been rendered a double-headed instrument of satisfaction, a highly pragmatical kind of doctrine. It justifies the will to power over others, humoring conceit of class or nationality or race; it allows the shirking of reality,

[2] Like the appeal to Providence, too, as the source of all things it checks research. For example, after a clear-sighted discussion of the evils of caste in India, Sir Herbert Risley in referring to its origin remarks: "Its precise origin is necessarily uncertain. All that can be said is that fictions of various kind have contributed largely to the development of early society in all parts of the world, and that their appearance is probably due to that tendency to vary, and to perpetuate beneficial variations, which seems to be a law of social no less than of physical development." ("The People of India," page 265. Calcutta and London, 1908).

i. e., of change as mere change. But the hour of this popular teaching draws to an end. Already its justification for group conceit has been challenged; its justification for shirking reality will be more lasting, but it too will pass, the need for it dwindling. Some day we shall be content to be assured merely of the disastrous effects of inflexibility, of failing to meet whatever change takes place. We shall stop clamoring for the assurance of progress from our social philosophy as we have stopped clamoring for the promise of heaven.

ELSIE CLEWS PARSONS.

NEW YORK CITY.

REVIEWS AND ABSTRACTS OF LITERATURE

Milton and Jakob Boehme: A Study of German Mysticism in Seventeenth-Century England. MARGARET LEWIS BAILEY. New York: Oxford University Press. 1914. Pp. vii + 200.

To the author of "Milton and Jakob Boehme" we owe gratitude for a clear, though brief, exposition of the place in seventeenth-century thought held by the Teutonic philosopher, of whose crabbed writing a contemporary translator said: "Though you know I alwaies affected it and him, yet durst never saile into the ocean of his vast conceits with my little skull, me thought the reading of him was like the standing upon a precipice or by a cannon shott off, the waft of them lickt up all my brains." Boehme's influence, though hardly so violent as here suggested, radiated far and deep into the consciousness of the two generations following his own.

One reason for his influence was the frankness with which he faced the mystery of evil. Although he believed in the oneness of God and nature, he conceived of man as a microcosm and of the human soul as self-existent and free to choose between its own latent good and evil. In its choice is manifest the law of opposition, with conflicting forces assimilated into harmony. The analogous harmonizing process in nature is brought about by seven organizing spirits, the first three representing the centripetal, centrifugal, and rotatory laws of motion, the fourth the pivot between the physical and the spiritual forces, and the last three the spiritual equivalents of the laws of motion. In this process of self-manifestation through opposition, both in God and in man, will is the dominant force.

Before elucidating Boehme's doctrines Dr. Bailey traces the history of mysticism from Plotinus through the seventeenth-century academies. The English line of descent, necessarily meager, would have seemed more nearly complete had Spenser been more searchingly examined and had Robert Southwell been mentioned for "The Burning Babe" and "At Home in Heaven." Contemporaneous with the emotional experiences of mysticism ran the intellectual attempt to control nature, first through magic and alchemy, later through modern science. Both interests were cultivated by the academies, which originated in Italy, were interrupted

by the Thirty Years' War, and survived in such modified forms as the Royal Society and the Society of Friends.

During Boehme's lifetime England became the nursery of nonconformist sects, not unlike the academies in their emphasis upon mystical experiences and social reform, and hence well adapted to absorb his teachings. His works, completely published in English between 1644 and 1662, enunciated the philosophical principles implicit in the sects and the academies. Among his distinguished readers were Charles the First, Samuel Pepys, and Sir Isaac Newton, who transcribed passages from Boehme, basing upon them experiments in alchemy. In William Law's works, as well as independently, Boehme's theories influenced the early Methodists. Tracing out the influence of his philosophical ideas upon scientists like Newton, upon religious reformers like Fox and Wesley, upon authors of ideal commonwealths like Samuel Hartlib, and upon political reformers like Sir Henry Vane constitutes the most valuable part of Dr. Bailey's book.

As for its main thesis, the conclusion that Milton knew something of Boehme's work is inevitable in view of his acquaintance with Hartlib, Vane, and Herring, all admirers of Boehme. In some respects Milton's convictions coincide remarkably with Boehme's, notably in emphasizing free will rather than predestination and in regarding Christ's victory over temptation instead of the crucifixion as counterbalancing Adam's fall. In not all cases, however, do Dr. Bailey's quotations prove that Milton learned from Boehme; more than once the quoted opinions are contradictory; Milton's condemnation of false teachers in "Paradise Lost" echoes a passage in "Lycidas" written a decade before Boehme's works began to be published in English; Milton's account of how Lucifer and his followers were turned into snakes shows close parallels with Ovid, Dante, Lucan, and Phineas Fletcher, but no distinctive feature in common with Boehme's brief account.

With a bird's-eye view of romanticism as permeated with a mysticism possibly derived from Milton and through him from Boehme, Dr. Bailey closes her study of an obscure, but important phase of German influence upon English thought.

ELIZABETH B. COLLIER.

HUNTER COLLEGE.

Kant's Doctrine of Freedom. E. MORRIS MILLER. London: George Robertson and Company. 1913. Pp. 181.

This little volume is a faithful endeavor to set forth Kant's doctrine of freedom as it originates in the "Critique of Pure Reason," and as it is developed in the "Analytic of the Critique of Practical Reason." The author's sympathies are clearly with the idealism of Green and Caird. The problem of freedom remained for Kant a problem because his method was one of abstract analysis. By avoiding Kant's theoretical abstractions, Green and Caird are able to outline a positive solution for the problem which Kant really leaves unsolved. The author is evidently familiar with a considerable amount of Kant literature, and has succeeded in giving a

consistent, though somewhat laborious, interpretation of the Kantian concept of freedom.

GEORGE P. ADAMS.

UNIVERSITY OF CALIFORNIA.

JOURNALS AND NEW BOOKS

MIND. April, 1915. *Mr. Betrand Russell on Our Knowledge of the External World* (pp. 145–183): H. A. PRICHARD. – An examination in considerable detail of Russell's views as stated in his "Lowell Lectures" and in *Scientia* for July, 1914. The writer disagrees with Mr. Russell's conclusions. *Lotze's Relation to Idealism* (pp. 186–206): I. I. THOMAS. – For Lotze metaphysical inquiries begin in pluralism; his theory of thought is opposed to idealism, but derived from a development within idealism. He held that the thought constitutive of experience is dependent upon the nature of sense. *Plato and the Tripartite Soul* (pp. 207–221): J. L. STOCKS. – We must amend our account of the origin of Greek ethics. The language of Platonic ethics is prophetic and oracular; the doctrine is mystical and ascetic. Plato owed much to the Pythagoreans, and the attribution to them of the tripartite soul was current in circles not hostile, but friendly to Plato. *Idealism and Religion in Contemporary Italian Philosophy* (pp. 223–239): ANGELO CRESPI. – The leading systems in Italy at present are that of Croce and that of Varisco. Croce's idealism is exclusively historical. History is the process of which philosophy is the rationale. Religion is but an inferior kind of philosophy. Varisco's starting-point and conception of philosophy is that of ordinary idealism. Varisco admits the value of feeling, recognizes only two alternatives, theism and impersonal pantheism, and defends the option for theism. Discussion. *Dr. Schiller on William James and on Realism* (pp. 240–249): R. B. PERRY. – Continues the discussion of points raised by Schiller in his review of Perry's "Present Philosophical Tendencies." *Critical Notices. New Books. Philosophical Periodicals. Notes.*

Bergson, Henri. The Meaning of the War: Life and the Conflict of Matter. New York: The Macmillan Company. 1915. Pp. 47.

Garrigou-Lagrange, P. Fr. R. Dieu: Son Existence et Sa Nature. Paris: Gabriel Beauchesne. 1915. Pp. 770. 10 fr.

Jastrow, Joseph. Character and Temperament. New York and London: D. Appleton and Company. 1915. Pp. xviii + 596. $2.50.

Mainage, Th. La Psychologie de la Conversion. Paris: G. Beauchesne. 1915. Pp. xii + 433. 4 fr.

Pedrick, Katharine Francis. The Practical Mystic or How to Make Perfection Appear. Boston: Sherman, French, and Company. 1915. Pp. 209. $1.25.

NOTES AND NEWS

THE following is an extract from a letter written by Professor Bergson to Professor H. M. Kallen, in reference to Professor Kallen's book, "William James and Henri Bergson."

"Pour ce qui est de l'exposé de mes vues, je vous remercie d'abord de les avoir rapprochés de celles de James; vous ne pouviez pas me faire un plus grand honneur. Je vous remercie ensuite de m'avoir étudié si sérieusement et si impartialement. Il vous était beaucoup plus difficile d'entrer dans mes vues que dans celles de James, puisque nous n'avons pas eu occasion d'en causer ensemble: vous ne vous étonnerez donc pas si je vous dis que, sur bien des points importants, il me serait impossible d'accepter tout-à-fait votre interprétation. Je ne puis malheureusement pas, aujourd'hui, entrer dans le detail. D'une manière générale, vous avez exagéré, ce me semble, ce qu'il peut y avoir de transcendant dans la doctrine. Vous avez sans doute raison de dire que je me rapproche plus que James de la métaphysique traditionelle; vous avez même deviné ma sympathie pour Plotin,—sympathie dont je n'ai jamais eu occasion de parler dans mes livres, mais que les auditeurs de mes cours connaissent bien. Mais je crains que vous ne vous soyez mépris sur la relation que j'établis entre la durée et "l'éternité." Je ne ramene pas la durée a "l'éternité" des anciens philosophes; bien au contraire; c'est "l'éternité" des anciens philosophes que j'ai cherché à faire descendre des hauteurs ou elle siègeait pour la ramener à la durée, c'est à dire à quelque chose qui se grossit, s'enrichit, et se crée soi-même indéfiniment. D'autre part, il n'est pas exact que j'admette l'existence d'une réalité absolue, distincte des apparences, à la manière de la métaphysique traditionnelle. Au contraire, selon moi, tout ce que nous percevons est une réalité absolue. Seulement, c'est une rèalité que nous devons *compléter* de plus en plus en renonçant à certaines habitudes, toutes pratiques, de *rétrécissement,* et c'est a connaître cette réalité plus complète que la réalité ordinaire (mais non pas d'une autre nature, puisqu'elle contient cette réalité ordinaire comme le tout contient la partie) que la philosophie doit viser. Il n'est pas exact non plus, de dire que je pose, a la manière de la métaphysique traditionnelle, une *unité* antérieure a la *multiplicité.* Au contraire, unité et multiplicité distincte ne sont pour moi que des *vues* prise sur quelque chose qui participe des deux sans être l'une ni l'autre, et que j'appelle "multiplicité qualitative," ou "multiplicité de pénétration réciproque," ou "durée." Tout mon effort depuis le jour oú j'ai commencé à philosopher, a porté sur cette considération d'une multiplicité *sui generis,* que les philosophes ont toujours laissée de coté parcequ'ils n'apercevaient de la durée que son symbole spatial, et qui est la réalité même. Il est vrai que pour rentrer dans cette durée, et par conséquent pour se représenter cette multiplicité, il faut faire un effort de dilatation intellectuelle, ou plutôt psychique, qui aboutit à la rupture de beaucoup de nos cadres.

"C'est vous dire que, selon moi, il y a moins de distance que vous ne le pensez entre les vues de James (surtout celles qui lui sont venues à

mesure que les difficultés des problèmes métaphysiques le préoccupaient davantage) et les miennes. Vous avez raison d'affirmer que James a été un démocrate en métaphysique; mais sa démocratie n'allait pas jusqu'à l'anarchie, et c'est une espèce d'anarchisme que vous lui pretez. James, en profond philosophe qu'il était, ne pouvait pas n'être pas frappé du fait que nos mathématiques sont applicables aux choses, et même qu'elles s'y appliquent de plus en plus exactement à mesure que nous approfondissons davantage le détail de la réalité. Nous faisons des calculs fondés sur le passé, et l'expérience a venir les vérifie, comme si les choses étaitent véritablement composées d'atomes et de corpuscules soumis aux lois de la mécanique. C'est cette mathématique inhérente aux choses que Berkeley et Hume n'avaient pas pu expliquer. S'ils l'avaient expliquée, le Kantisme ne se serait probablement pas produit, car il aurait été inutile. Kant a justement cherché à expliquer comment les mathématiques sont applicables à un monde tel que se le figure l'empirisme radical; mais, pour cela, il a été obligé de réduire l'empirisme à une connaissance de "phénomènes," et de supposer derrière les phénomènes des "choses en soi," situées hors du temps. Or, un des principaux objets de mes travaux a été de donner la solution de ce même problème à moins de frais que ne l'avait fait Kant, sans supposer de "choses en soi" distinctes des phénomènes, et en montrant que les phénomènes, pris dans leur intégralité, c'est-à-dire replacés dans la "durée réelle," sont véritablement un absolu,—cet absolu étant alors d'une telle nature que, nécessairement, il se prête à la connaissance intellectuelle ou mathématique quand il est matière, à la connaissance intuitive quand il est vie ou esprit. Ou je me trompe beaucoup, ou c'est là qu'il faut chercher la véritable raison de la sympathie de James pour mes travaux, surtout pour les conclusions générales de l'"Evolution créatrice." Ce n'est pas seulement, comme vous le dites, à la theorie du concept qu'il donnait son approbation. Il voyait sans doute aussi que c'est dans cette direction-là qu'il faut chercher la clef de l'accord entre l'expérience et la science.

"Certainement, James était arrivé a son "stream of consciousness" par des voies purement psychologiques. Certainement aussi, c'est par la critique de l'idée mathématique et physique de temps, et par la comparaison de cette idée avec la réalité, que j'ai été conduit à ma "durée réelle." Cette difference *d'origine* explique la difference de *fonction* de la "durée" et du "stream." Le "stream of thought" a surtout une puissance d'explication psychologique, tandis que la "durée" a principalement une puissance d'explication épistémologique ou, si vous voulez, métaphysique. Mais entre ces deux manières de voir il n'y avait pas opposition; il y avait plutot "harmonie préétablie."

"En résumé, il me semble que vous me poussez, moi, beaucoup trop dans le sens de l'unité, de la "monarchie," et que vous poussez trop James dans le sens d'une multiplicité qui serait absoluement "anarchique" et, par là, discontinue. L'intervalle devient alors si considérable que vous apercevez nécessairement des contrastes irreductibles."